最終氷期および二酸化炭素倍増気候下における南極棚氷底面融解のモデリング

小長谷貴志[1]、阿部彩子[1]、草原和弥[2]、羽角博康[1]
[1] *東京大学大気海洋研究所*
[2] *北海道大学低温科学研究所*

Modelling Antarctic ice shelf melting under LGM and doubled CO2 climate using ice shelf-ocean model and climate model

Takashi Obase[1], Ayako Abe-Ouchi[1] , Kazuya Kusahara[2] and Hasumi Hiroyasu[1]
[1]*Atmosphere and Ocean Research Institute, the University of Tokyo*
[2]*Institute of low Temperature Science, Hokkaido University*

Ice-ocean interaction is thought to be a responsible process on long-term Antarctic ice sheet variations, such as retre at of West Antarctic Ice Sheet during Eemian interglacial. Numerical simulation of Antarctic ice sheet require melt rate at ice shelf base as a boundary condition, but the relation between climate and melt rate is unclear.

We calculate Antarctic ocean and basal melting of Antarctic ice shelves under Last Glacial Maximum(LGM) and doubled CO2 (2xCO2) climate at equilibrium as well as present-day(CTL). We use circumpolar ice shelf-ocean general circulation model(OGCM, based on COCO, Kusahara and Hasumi, 2013) and outputs of climate model(MIROC).

For the CTL case, we drive OGCM with surface atmospheric climatology based on reanalysis(OMIP) and present-day ocean temperature and salinity for restoration at northern boundary, placed at around latitude of 40S.

The surface boundary conditions for LGM(or 2xCO2) is computed from the outputs from climate model simulations. Annual mean marine 2m air temperature anomaly averaged for south of 50S is -7.3℃ for LGM and +6.0℃ for 2xCO2. LGM (or 2xCO2) anomalies of surface atmospheric variables are superimposed to OMIP to make LGM (or 2xCO2) atmospheric boundary conditions. We modify the ocean temperature and salinity column for restoration at northern boundary by superimposing anomaly to present-day ocean climatology.

Present-day geometry of ice sheet and ice shelf is used in all experiments to test the sensitivity to climate.

The standard experiment shows that melting amount of Antarctic ice shelves show 23% reduction for the LGM and 3.5 times increase for the 2xCO2 compared to the CTL case.

We perform a series of additional sensitivity experiments to investigate the role of surface change in sea surface atm ospheric variables (temperature, wind) and ocean structures in the Southern Ocean on melt rate of ice shelves. Water mass, o cean circulation and sea ice production on continental shelf are analyzed.

References

Kusahara, K. and H. Hasumi, 2013: Modeling Antarctic ice shelf responses to future climate changes and impacts on the ocean. J. Geophys. Res. Oceans, 118(5), 1–22.